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SPOTTING OF PEACHES AND CUCUMBERS. PROF. J. C. ARTHUR.

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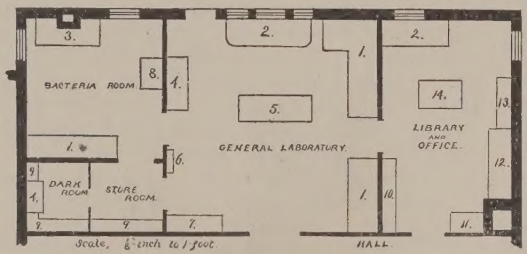
THE BOTANICAL DEPARTMENT.

The following plan and brief description of the rooms specially devoted to the botanical work of the Station will give some idea of the facilities provided for this department.

The rooms are on the first floor of the central part of the building, facing south. There are two entrances from the hallway, one into the library and office, a room twelve by twenty feet, and another into the general laboratory, twenty feet square, which also has a door leading to the garden beyond.

The library room contains the botanical books and periodicals belonging to the Station, the herbarium, a case for delicate and special apparatus, a table for microscopic work and a writing desk.



PLAN OF BOTANICAL ROOMS.

1, 1, 1. Desks with shelves above and drawers below.
2, 2. Microscope tables.
3. Hood. 4, 4. Sinks.
5. Working table.
6. Reagent case.
7. Photographic apparatus.
8. Refrigerator.
9, 9, 9. Shelving.
10. Book case.
11. Catalogue table.
12. Herbarium case.
13. Case for fine instruments.
14. Writing desk.

The general laboratory is especially fitted for research in vegetable physiology. It is conveniently supplied with water, gas and drainage at the desks and central table, with both hot and cold water at the sink, and with many devices for particular lines of work not easily described in a limited space. In front of the large triple window is a table for microscopic work, and against the walls are cases containing a supply of reagents, glass ware, and various kinds of apparatus.

The bacteria room has an excellent outfit for the study of microbes, such as produce germ diseases, nitrification of soils, putrefaction, etc. The apparatus has been mostly imported from Germany.

A store room with suitable shelving and wall hooks receives apparatus and supplies when not in use. Beyond is a dark room chiefly devoted to photographic purposes.

A small greenhouse will shortly be added to the laboratory to provide growing plants at all seasons of the year for experimental use.

SPOTTING OF PEACHES AND CUCUMBERS.

Fruit grown in perfection is without spot or mark, except that which comes from natural coloring or structure, and which usually adds to its attractiveness. Most of the larger fruits, particularly those of the orchard, are often seen, however, with black or brown flecks, extending frequently into spots of considerable size, much disfiguring if not also distorting their fair proportions. The poorer the crop the more likely the spots are to show. Some cultivators have reasoned from this that the spots come because the plant is wanting in vigor, and that perfectly healthy growth will not be attacked. There are doubtless some grains of truth in this view, but a more intimate acquaintance with the origin and development of the spots brings the matter into a different light. The object of the present paper is to add something to the general information regarding the subject, and especially to describe two varieties of this class of maladies which have not heretofore received due notice. The drawings, from which the cuts illustrating this article were made, were done by Mr. H. L. Bolley, assistant in the botanical laboratory of the Station.

SPOTTING OF PEACHES.

The fruit of the peach is particularly free from surface blemishes; but in Indiana, over how much wider territory can not now be

FIG. 1.—Peaches showing spots caused by the fungus, *Cladosporium carpophilum*. Two-thirds natural size.

stated, there occurs a spotting of the full grown fruit, which in some seasons entails a loss of as much as ten per cent. of the value of the crop, and doubtless in exceptional cases of even a still larger percentage. The spots appear as brownish discolorations of definite outline, round, and barely an eighth of an inch across. They are scattered about over the surface of the fruit (Fig. 1), but are most abundant on the upper side as it hangs on the tree, consequently are generally more conspicuous on one of the faces toward the stem end, where the spots frequently coalesce and produce a broad brownish, or at length blackish, patch.

The spots are caused by a fungus. It is a fungus closely related to those which produce the scab of apples and pears, and under the microscope shows as a mass of small filaments growing out from the surface of the fruit.

The down of the peach very much interferes with the early detection of the spots, and modifies their after appearance. It is made up of straight, pointed, thick-walled but soft hairs, each hair formed from a single cell growing out from the general surface of the fruit (Fig. 2). Among these hairs the fungus finds a lodgment. As it grows the filaments attach themselves closely to the surface between the hairs, and form a mat of short plump cells, which give rise to numerous upright filaments bearing spores (Fig. 3). The fungus does not penetrate the tissue of the peach at all, but is closely appressed to the surface and absorbs nutritive fluids from the fruit through the unbroken cell-walls. Occasionally, when the fungus starts early in the season and the weather specially favors its development, the parasite makes such heavy demands on the host for nourishment that the cells just under the spot become much enfeebled, fail to reach their full growth, and may in exceptional cases so far lose vitality that a layer of cork is formed beneath them. Interposing a layer of cork is the customary way in which plants protect injured parts, unless they have the power of producing some kind of gum that covers the wound and acts like a salve or plaster.

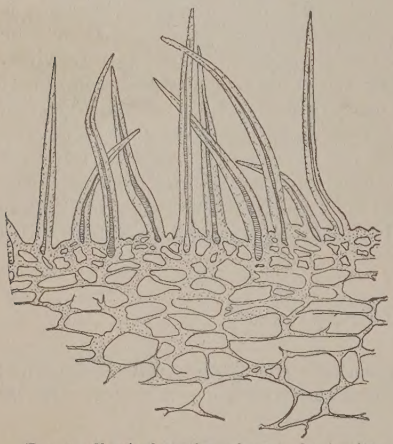


FIG. 2.—Vertical section of part of a healthy peach, showing the hairs which form the down and some of the flesh just beneath the surface of the fruit. Magnified 190 diameters.

The fungus is of a deep olive brown, but being intermixed with the light colored hairs the color of the spots is correspondingly modified. The hairs as a rule are longer than the filaments of the fungus, and greatly exceed them in thickness. As a consequence of this the fungus attains considerable age before its presence is detected, and up to the time the fruit is gathered does not become sufficiently conspicuous to seemingly account for the injury to growth that it undoubtedly causes.

The fungus is reproduced and disseminated by means of spores borne on the outer ends of the filaments (Fig. 4 A). The spores are nearly oblong, with ends blunt or somewhat pointed, and single-celled or occasionally two-celled (Fig. 4 B). They germinate when placed in water at proper temperature by sending out jointed branched filaments from one side (Fig. 4 C), which much resemble the vegetative part of the fungus that creeps along in immediate contact with the surface of the fruit.

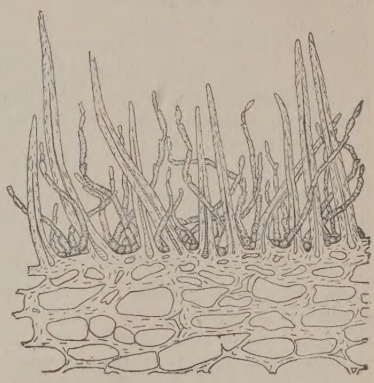


FIG. 3.—Same view as in Fig. 2, but taken from a spotted fruit, showing the growth of the fungus between the hairs. Magnified 190 diameters.

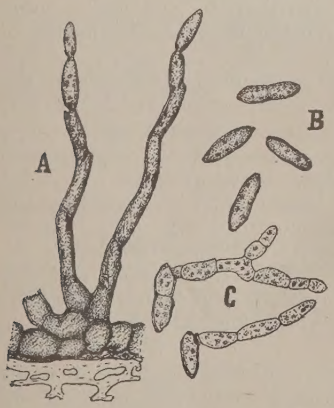


FIG. 4.—The fungus more enlarged: *A* two filaments rising from the creeping basal portion, bearing immature spores; *B* mature spores; *C* spores germinating. Magnified 525 diameters.

The name of the fungus is *Cladosporium carpophilum*, given it in 1877 by von Thuemen,* botanist to the Austrian Experiment Station for wine and fruit culture at Klosterneuburg near Vienna. In his work on the fungi infesting fruit he has given an emended technical description of the species,†

* Oesterr. bot. Zeitschrift, 1877, p. 12; Wiener landw. Wochenblatt, 1877, p. 450.

† CLADOSPORIUM CARPOPHILUM Thuem.—Spots orbicular, often confluent, greenish-black, becoming rings; hyphæ short, erect, flexuous, continuous or occasionally septate, somewhat branched, slender, 4 mikros thick, fuscous; spores ovate-fusiform, somewhat obtuse at both ends or rarely sub-acute, straight, obscurely or not at all uniseptate, diaphanous, 20 mikros long, 5-6 mikros wide, pale fuscous. On the mature fruit of *Persica vulgaris;* epidemic. Lower Austria. Fungi Pomicoli, 1879, p. 13.

with notes on its occurrence. Saccardo's Sylloge Fungorum, a work containing descriptions of all known fungi, copies von Thuemen's description, slightly abbreviated, in the fourth volume, issued in 1886, but without mention of any other locality than that of Klosterneuburg. The spotting seems to have first attracted attention in 1876, during which year and the year following it was so prevalent in the vicinity of Vienna, as we are told by von Thuemen, that from a basket full it was difficult to select a dozen peaches not affected with the fungus.

So far as the writer knows the references already cited regarding its occurrence in lower Austria give the only accounts of the disease published up to the present time. The absence of any mention of it in the large works on plant diseases by the German botanists, Frank and Sorauer, makes it certain that the disease is of very rare occurrence or entirely absent in Germany. In the United States it appears to be prevalent in the interior, and although it does not seem to have attracted the attention of investigators, yet it has been known to the people of Indiana for many years. The general impression is that it is the result of dry hot weather, from which I judge that temperature and moisture are the chief factors which control its abundance and distribution, and that a more equitable and moist climate has saved the large peach districts of other states from its depredations.

The injury done by the fungus is twofold—it decreases the market value of the fruit by discoloring the surface, and it prevents the fruit from reaching full size by appropriating the nutriment to its own growth. It does not appear, however, to affect the taste of the fruit, and does not directly lead to decay. Yet whatever weakens the vitality of the tissues at any point must necessarily tend to decrease the power of resistance to decay; and it is the opinion of von Thuemen, who has had better opportunities for observation in this regard than I have, that fruit spotted with the fungus does in fact show more decay than sound fruit. He also says that it can not be shipped to a distance as successfully as when sound.*

No remedies have yet been tested, but trial might be made by spraying the tree in June with sulphide of potassium, using one ounce to four gallons of water, or sulphate of copper, using one pound to twenty-two gallons of water.

SPOTTING OF CUCUMBERS.

This spot disease was observed at Geneva, N. Y., during 1887, when it was so abundant as to ruin the crop for pickling. Brief reference has already been made to it in the report of the New

* Fungi Pomicoli, p. 15.

York Experiment Station for 1887 (p. 316), and in a short article by Mr. M. H. Beckwith in the American Garden. It is mentioned in this connection because produced by a similar fungus to that on the peach, and in order to call the attention of Indiana cultivators to it, so that if it appears in the state it may be reported to the Station for further study.

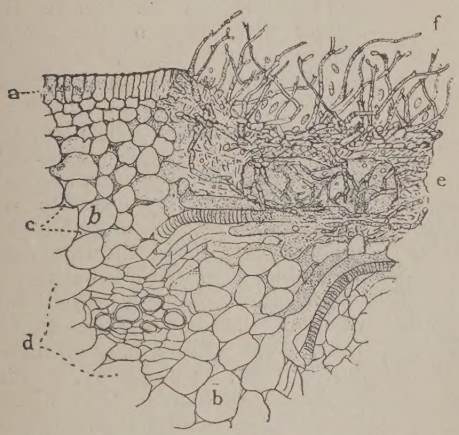


FIG. 5.—Vertical section through part of a spot on young cucumber showing both healthy and diseased tissues: *a* epidermis; *b b* parenchyma cells, between which are air spaces *c*, filled with gum near the fungus spot; *d* fiber-bundle cut across; *e* mass of gum and fungus filaments; *f* spore-bearing filaments. Magnified 150 diameters.

The spots begin when the fruit is only an inch or two long, and show as gray slightly sunken places, with minutely velvety surface, usually about an eighth of an inch across, but running together into much larger irregular patches, particularly toward the flower end. Drops of a gummy substance frequently accompany the spots, giving the erroneous impression of insect punctures. The spots grow darker colored with age, becoming greenish-black, and form a small cavity just beneath the fungus-covered surface.

This formation is brought about by the fungus penetrating the tissues of the cucumber and setting up a morbid activity of the cells, resulting in an outflow of the gummy substance already referred to. This substance fills up the spaces between the cells within the range of the fungus, accumulates more and more, the walls of the cells gradually disappear, and a considerable mass of thin pale yellow gum is the result. It evidently furnishes a suitable medium for a luxuriant development of the fungus, which sends its filaments through it in a network of branches (Fig. 5 *e*), and from the surface the branches rise into the air and produce spores. The volatile part of this mass gradually evaporates, leaving a film made up of solid gum and fungal filaments stretched across a cavity an eighth of an inch deep or more.

The spores and spore-bearing filaments (Fig. 6) have considerable resemblance to those of the peach fungus. The spores germi-

FIG. 6.—Spores and spore-bearing filaments of the fungus *Cladosporium cucumerinum*. Magnified 600 diameters.

nate in a few hours after placing in water, and send out filaments more slender and uniform in diameter than those of the peach fungus shown in Fig. 4.

The fungus is an undescribed species of Cladosporium. In connection with Mr. J. B. Ellis, of New Jersey, who has also examined it, the name *Cladosporium cucumerinum* E. & A., is proposed for it. There appears to be no published account of it, or of the injury it does, other than that cited above.

While it quite destroyed the value of the crop at Geneva in 1887, it was not noticed at all there during 1888, or elsewhere, so far as the writer knows. The injury is of the same nature as that of the peach, but more pronounced, as the parasite is more aggressive. No remedies have been tried.

SUMMARY.

The preceeding account may be briefly summed up thus:

The spot disease of peaches common in Indiana is due to a fungus only recorded heretofore as occurring in southern Austria. Its presence detracts from the beauty and therefore the market value of the fruit and hinders its full growth, but does not affect the taste. Methods of keeping it in check have not yet been worked out.

The spot disease of cucumbers, observed in one locality in New York during 1887 only, is caused by a closely related fungus. It disfigures the fruit to an extent that renders it unsuitable for pickling, although it does not affect the taste. No remedies have been tried.

J. C. ARTHUR,
Botanist.

LAFAYETTE, Ind., January 1, 1889.

To the Farmers of Indiana:—

In order to carry out the purposes of the Station in the spirit in which it was established and to make its results directly available to its patrons, those connected with its work desire to place themselves in intimate relation with the farmers and horticulturists of the State, and thereby learn what problems are of immediate practical importance to them, and also secure co-operation in making trials and observations. All persons interested in the Station, therefore, are invited to state such questions and problems as may be of moment to them, and which lie within the province of the Station, to which answers will be returned as far as possible.

Investigation and examination of material requiring considerable time can not be undertaken unless the results obtained are likely to be of general public interest, and such results will be the property of the Station for use and publication.

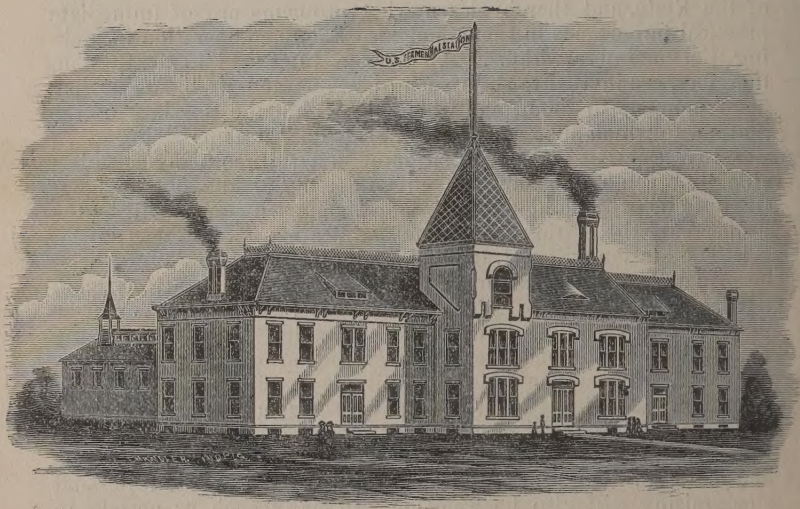
The Station will test, by field trial, different varieties of wheat, corn, oats, grasses, and forage plants suited to this latitude, and particularly such as are grown in this State. Similar tests will be made of new varieties of fruits and vegetables Inquiries relating to beneficial or noxious insects, and of the various fungous diseases of plants, when accompanied by suitable specimens, will receive attention. The Station is also prepared to examine into the purity and germinating power of seeds, and to give information regarding soils, fertilizers, cattle foods, milk and other agricultural products and material. Questions relating to certain phases of dairying and stock-raising will also be welcome, especially such as pertain to milk and butter and the contagious diseases of animals.

Contributions of seeds or scions of new or promising varieties for the field, orchard or garden are solicited, and also samples of agricultural products, such as grains, seeds, grasses, vegetables, etc., that may be of service in identification and comparison. All gifts will be acknowledged in the annual volume.

Persons contemplating sending samples for chemical analysis should apply to the Station for blanks and directions for sampling, and in all cases of large or bulky specimens, or of seeds for field tests, instructions regarding the same should also be obtained before forwarding. Address,

DIRECTOR OF EXPERIMENT STATION,

Lafayette, Ind.



STATION BUILDING.